

Missouri Department of Natural Resources

Total Maximum Daily Load Information Sheet

Mississippi River

Water Body Segment at a Glance:

County: Jefferson
Nearby cities: Herculaneum
Length of classified segment: 195.5 miles
Length of impairment within segment: 5 miles
Pollutants: Lead and Zinc
Source: Herculaneum Smelter
Water Body ID: 1707



State map showing location of Herculaneum Smelter

Scheduled for TMDL Development: Approved by EPA 2010

Description of the Problem

Designated Beneficial uses of Mississippi River

- Livestock and Wildlife Watering
- Protection of Warm Water Aquatic Life
- Protection of Human Health (Fish Consumption)
- Irrigation
- Whole Body Contact Recreation – Category B¹
- Secondary Contact Recreation
- Drinking Water Supply
- Industrial

Uses that are impaired

- Protection of Warm Water Aquatic Life
- Protection of Human Health (Fish Consumption)

¹ This category applies to those water body segments that have places deep enough for total immersion (i.e., swimming), but they may be on private lands or inaccessible to the public. See 10 CSR 20-7.031(1)(C)8.A.

Standards that apply

- Missouri Water Quality Standards (WQS) do not contain numeric criteria for metals in sediment. However, elevated levels of lead and zinc in Mississippi River sediment adjacent to and downstream of the Herculaneum smelter represent a violation of the general criteria found in the WQS 10 CSR 20-7.031(3), where it states:
 - (D) Waters shall be free from substances or conditions in sufficient amounts to result in toxicity to human, animal or aquatic life.
 - (G) Waters shall be free from physical, chemical, or hydrologic changes that would impair the natural biological community.
- Moreover, 10 CSR 20-7.031(4)(B) of the water quality standards creates a linkage with the general criteria above to the specific criteria for toxic substances by stating:

Water contaminants shall not cause the criteria in Tables A and B to be exceeded. Concentrations of these substances in bottom sediments or waters shall not harm benthic organisms and shall not accumulate through the food chain in harmful concentrations, nor shall state and federal maximum fish tissue levels for fish consumption be exceeded.

- Chronic criteria for lead and zinc are derived using equations specified in Missouri's water quality standards at 10 CSR 20-7.031, Table A and expressed as dissolved instream concentrations per 10 CSR 20-7.031(4)(B)2.A.(II). These criteria are hardness dependent and are calculated using the 25th percentile hardness value from available data per 10 CSR 20-7.031(1)(Y) and the following equations:

$$\text{Chronic dissolved lead WQS } (\mu\text{g/L}): e^{(1.273 \cdot \ln(\text{Hardness}) - 4.704797) * (1.46203 - (\ln(\text{Hardness}) * 0.145712))}$$
$$\text{Chronic dissolved zinc WQS } (\mu\text{g/L}): e^{(0.8473 \cdot \ln(\text{Hardness}) + 0.785271) * 0.986}$$

Background information and water quality data

Storm water runoff from the area around the Herculaneum smelter flows into Joachim Creek and the Mississippi River. Runoff carries with it fine sediment from the area and the slag pile adjacent to the creek. Historic attempts to analyze sediment in Joachim Creek have failed, however, due to a lack of fine sediments in the creek downstream of the smelter. These sediments were most likely washed into the Mississippi River during high flow events and metals have been detected below its confluence with Joachim Creek. Levels of lead and zinc reported in some Mississippi sediments (see Table 1 below) are well in excess of values commonly reported as toxic to aquatic life. Zinc is an essential nutrient to aquatic and terrestrial organisms, but in excess quantities both lead and zinc can be highly toxic to aquatic life.

Lead is known to bioaccumulate in bottom feeding fish, such as sunfish, carp or suckers. Consumption of fish containing sufficient quantities of lead may cause human health problems. In humans, lead primarily affects the nervous system, blood cells and processes for the metabolism of Vitamin D and calcium. Lead can affect the developing fetus during pregnancy and may cause lower IQ scores in children. Lead poisoning may also result in poor attention spans, hearing, speech and language problems, reading disabilities, reduced motor skills and poor hand-eye coordination. Evidence suggests that lead toxicity may occur at levels as low as 10 micrograms per deciliter ($\mu\text{g/dL}$) of blood. Although neither the TMDL nor the assessed impairment are based on fish tissue data, high levels of lead in the fish tissue have been reported.

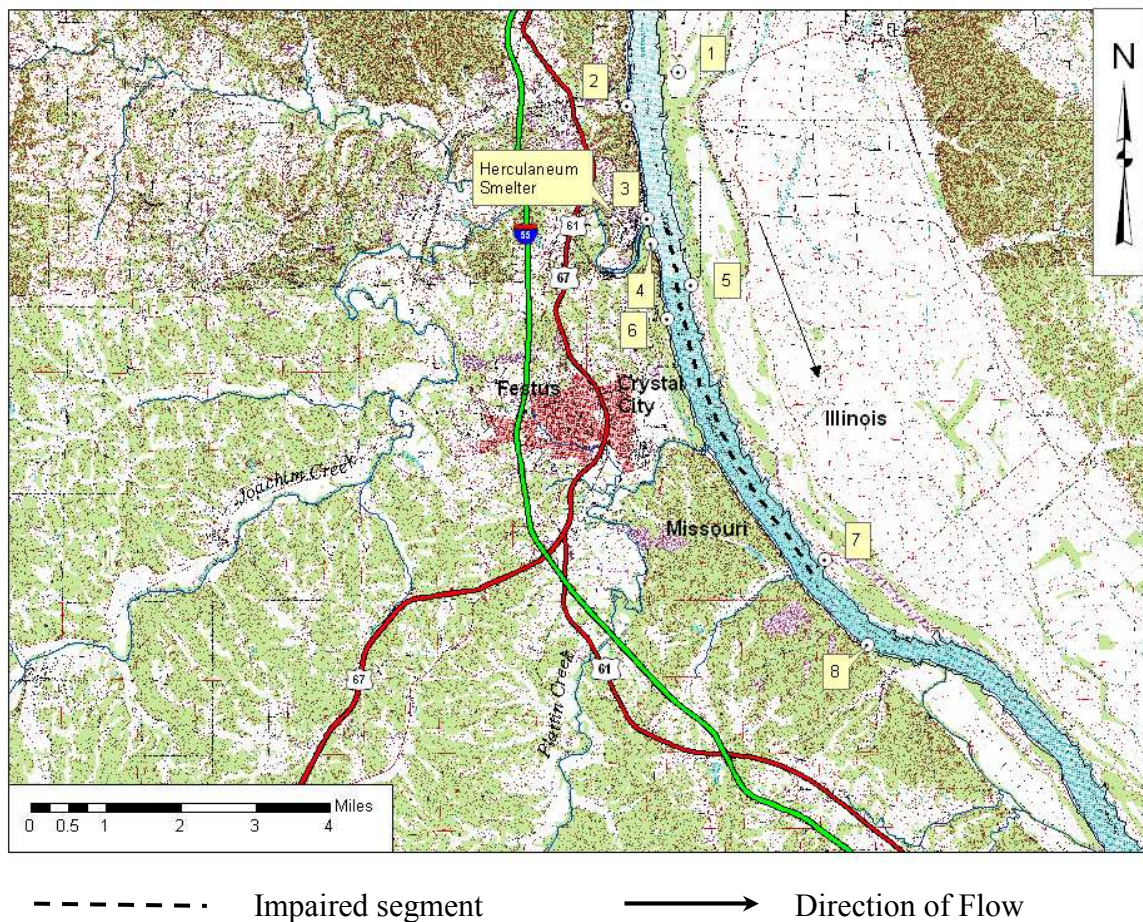
Table 1. Metals in Mississippi River sediments (mg/kg, dry weight), 2001, 2004								
Note: Milligrams per kilogram (mg/kg) is the same as parts per million.								
Site - date	Arsenic	Cadmium	Chromium	Copper	Lead	Mercury (ug/kg)	Nickel	Zinc
1 - 12/01	7.5	0.372	31.6	13.75	16.9	19.99	19.25	60.55
1 - 7/04	4	1.14	10	5.1	8.06	16	9.61	45.2
2 - 7/04	6.53	0.26	19.9	12.9	13.1	21.7	16.3	56.5
3 - 12/01	7.56	4.02	0.2499	145	1710	19.99	35.3	4920
4 - 12/01	4.36	0.293	16.3	6.5	21.3	19.99	10.3	33.6
5 - 7/04	4.88	0.151	11.5	5.87	9.02	16.7	10.5	43.9
6 - 7/04	5.33	0.25	15.4	10.28	13.25	18	13.3	47.6
7 - 12/01	5.95	0.237	24.5	8.51	11.7	19.99	14.5	49.8
8 - 12/01	5.08	0.373	23	6.98	11.8	19.99	11.7	39.4

In fiscal year 2009, the department collected metals in sediment samples at one site downstream of Herculaneum, Mo. In addition, the US Geological Survey is under contract to collect heavy metals in sediment in the Mississippi River from mid-St. Louis to Chester, IL. The purpose of these sampling efforts is to bracket the Meramec River and Joachim Creek to determine input of heavy metals into the Mississippi River.

To remedy the problem of fine sediment contaminated with lead and zinc leaving the Herculaneum Smelter site, a Superfund cleanup is underway. The selected removal action consists of engineering measures to contain and treat stormwater runoff; control wind and water erosion; prevent direct contact other than by employees or contractors of Doe Run; and provide for flood protection, long-term stability, and mitigation of wetlands disturbance. This remedial action includes the construction of a flood protection berm, a storm water retention basin and an engineered cover for the slag material following grading work. Work continues on these and other response activities.

The U.S. Environmental Protection Agency, or EPA, approved the Mississippi River TMDL for lead and zinc Dec. 9, 2010.

Sampling Sites on the Mississippi River Near Herculaneum, Missouri



Sample Sites on the Mississippi

- 1 – River Mile 154.2; 1.5 miles above Joachim Cr. LDB
- 2 – River Mile 153.7; 1 mile above Joachim Cr. RDB
- 3 – River Mile 152.75; Herc. Smelter outfall, RDB
- 4 – River Mile 152.5; 0.2 mile below Joachim Cr. RDB
- 5 – River Mile 151.4; 0.5 mile below Joachim Cr. LDB
- 6 – River Mile 150.6; 1.3 miles below Joachim Cr. RDB
- 7 – River Mile 147.8; 4.9 miles below Joachim Cr.
- 8 – River Mile 146.1; 6.6 miles below Joachim Cr.

Note: LDB = left descending bank; RDB = right descending bank

For more information call or write:

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Water Protection Program

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